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Managing an Instrumented Protective Systems Program for a Petrochemical Facility

J. Gregory Hall*
Eastman Chemical Company
*Presenter E-mail: jghall@eastman.com

INTRODUCTION

An Instrumented Protective Systems (IPS) program reduces the risk associated with health and safety effects, environmental impacts, loss of property, and business interruption costs in a petrochemical facility. IPS are composed of any combination of sensor(s), logic solver(s), and final element(s) used to implement protective functions that detect abnormal or unacceptable operating conditions and take action on the process to achieve or maintain a safe state. The objective of the program is to identify the activities necessary to ensure the design, operation, and maintenance of IPS throughout their life cycle, from inception through decommissioning, and to ensure the functional safety requirements of identified Safety Instrumented Systems (SIS) are met.

Upper management support is necessary for an IPS program to be successful. The program is managed by a group of personnel committed to process safety. Operating facilities are driven to make production quotas while managing process safety risk. The IPS group helps operating departments comply with company IPS policies, procedures, and standards. Upper management is the authority of jurisdiction to ensure the operating departments comply.

IPS PROGRAM ELEMENTS

An IPS program is based on a RAGAGEP (Recognized and Generally Accepted Good Engineering Practice). Typically, North American petrochemical company programs are based on ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1 Mod) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector –Part 1: Framework, Definitions, Systems, Hardware and Software Requirements", NFPA standards, API practices, and other practices and standards. The ISA standard specifically addresses safety instrumented systems (SIS) but can be broadened to include all IPS including SIS, safety, and non-safety interlocks. The following IPS program elements were adapted from the ISA standard.

1. Hazard and Risk Assessment

   The hazard and risk associated with each IPS interlock is assessed by the safety department using the appropriate methodology (e.g., formal safety reviews, Process Hazard Analyses (PHA), Layers of Protection Analyses (LOPA)).

2. IPS Classification Assignment

   Each IPS interlock is assigned an IPS classification based on the hazard and risk assessment see Figure 1.

3. IPS Classification Requirements

   Each IPS interlock is designed, documented, installed, commissioned, operated, tested, and maintained to specific requirements.

4. Design and Engineering Requirements

   Each IPS interlock is designed to company standards. SIS and safety interlocks are reviewed by the IPS group before being issued for construction. Any changes during a project that affect an IPS classification are reviewed to determine if the classification is valid or must be changed.

5. Application Software Requirements

   Each IPS interlock is configured and programming to specific requirements. Security and access to the logic solver software is important to the integrity of each interlock.

6. Installation, Commissioning, and Validation Requirements

   Each IPS interlock is installed according to the drawings and other documentation. Commissioning includes full functional testing. Each SIS interlock is validated to ensure compliance with LOPA requirements.

7. Operation Requirements

   The operating department ensures all IPS are operated, maintained, and tested as required.

8. Maintenance Requirements

   Each IPS interlock that can be defeated or bypassed during normal operation has an operating procedure describing operator action when defeated or bypassed. On-line calibration and

maintenance capability of interlocks is provided for processes that operate continuously and are only shutdown during planned outages.

9. Proof Test Requirements

A proof test procedure is developed for each SIS and safety interlock to perform a proof test per the specified time interval. A copy of each completed test is stored in a instrumentation computer database.

10. Modification

Any modification to an IPS interlock is reviewed by the IPS group to ensure the IPS classification remains valid.

11. Information and Documentation

Each IPS interlock is properly documented and recorded in an instrumentation computer database.

12. Grandfathered Safety Interlocks

Each grandfathered safety interlock is properly documented and tested on a specified time interval. Any modification to a grandfathered interlock is reviewed to determine if the interlock can remain grandfathered.

RESPONSIBILITIES

It takes a coordinated effort of different departments and groups to manage an IPS program. This effort is managed by the IPS group with the backing of upper management.

1. IPS Group

The IPS group is responsible for managing all aspects of the IPS program, developing policies, procedures, and standards regarding the design, construction, maintenance, verification, and testing of IPS, and assisting operating departments with compliance to company policies, procedures, and standards.

The group is composed of different engineering disciplines and expertise.

- IPS design engineer
- Safety department engineer
- Safety department LOPA expert
- Instrument engineer

- Process technology engineer
- Process control engineer
- DCS/PLC engineer
- Other members as needed

2. Safety Department

   Safety department representatives work with each operating department to assess and classify IPS interlocks within their responsibility. They perform the hazard risk analysis including LOPA when required.

3. IPS Design Engineer

   The IPS design engineer is responsible for ensuring IPS interlocks are properly designed, SIS interlocks meet LOPA requirements, and SIL verification calculations are completed. They work with all parties involved to develop and maintain procedures regarding the design, construction, maintenance, verification, and testing of IPS.

4. Operating Department

   Each operating department is responsible for developing and maintaining procedures regarding the design, construction, maintenance, verification, and testing of IPS in their area. They work with the maintenance department to ensure instrument calibrations and interlock testing is done within the required time intervals.

5. Maintenance Department

   The maintenance provides qualified technicians who are properly trained to perform maintenance, calibration, and testing of IPS interlocks and all associated instrumentation. Failure information is documented and recorded in a computer data base.

6. Documentation Services

   Documentation services create and update instrument and interlock records in a computer data base. Failure data is reported to the engineering, operating, and maintenance departments to correct any deficiencies with existing instrumentation and interlocks.

7. DCS/PLC Group

   The DCS/PLC is responsible for the configuration and programming of all IPS to ensure consistency and standardization throughout the plant site.

CONCLUSION

It is not an easy task to manage a life-cycle IPS program for a petrochemical facility that operates 24/7. Different departments, and groups must work together to ensure all parts of the program are covered. Upper management provides necessary personnel, training, equipment, computer resources, and expertise to ensure the program is successful. The IPS group is the key to managing the program. The maintenance and operating departments provide feedback used to improve the design, installation, commissioning, and operation of IPS interlocks. A successful IPS program reduces the potential risk associated with health and safety effects, environmental impacts, loss of property, and business interruption costs.

Figure 1 – IPS Classifications